LA-UR-19-24867
Approved for public release; distribution is unlimited.

Title:	“Continuous Flow Biocatalytic Generation of Green Propellant Fuels”
Author(s):	Evans, Amanda Christine
Intended for:	Proposal Abstract
Issued:	2019-05-28

Rocket propulsion has largely relied on the monopropellant hydrazine for the past four decades. However, hydrazine is both highly toxic and highly flammable, requiring expensive cold storage, specialized handling, and complex disposal protocols. Alternative propellant fuels for powering satellites and spacecraft offer greener and safer solutions that are more efficient (energetically dense) and less expensive, and on-demand manufacturing approaches eliminate stockpiling and storage needs for ensuring user-ready access to rocket fuels.

This project lays the groundwork for supporting both human and vehicular transportation in extreme environments such as space by developing renewable, safe, and sustainable generation pathways for propellants. Biomass waste streams will be repurposed for on-demand continuous biocatalytic generation of rocket propellants using microfluidic reactors. Demonstration of sustainable and recyclable processes for manufacturing propellant fuels from waste will support future deep space missions requiring great longevity and payload efficiency. Thus, “on-demand” propellants with superior performance to hydrazine will be enabled by the proposed project (currently TRL 2/3).

The training portion of this project will be highly interdisciplinary, with mentorship provided by both LANL and UCI investigators to address the project goals. Mr. Spano will play an integral role in the fabrication of a microfluidic platform, immobilization of enzyme activity within the microreactor, characterization of the product stream for real-time analysis, dimensioning the reaction steps and combining, or “telescoping”, multiple steps for fuel manufacturing. Inline characterization data will provide real-time process monitoring for quality assurance. This effort will generate significant progress, starting at TRL 2/3 and finishing at TRL 4/5. If funded, Mr. Spano will also participate in the development and automation of this technology for deployment to space’s microgravity environment.

This research can only take place within the framework of the UCLFR program. The green propellants proposed for this project require national lab expertise in safe handling and deployment, and the continuous flow biosynthetic manufacturing approaches leverage research capabilities from both the Weiss lab at UCI and the Evans Group at LANL.

This project will consolidate advanced technologies with proprietary work at LANL for publication as internal national lab communications and as high-impact publications. Follow-on funding for this project will be sought from NASA, CASIS, DoD and DTRA by the mentors at the two institutions in coordination with LANL Program Managers and the Feynman Center for Innovation.